provided all applicants are given an opportunity to amend their applications to meet any new requirements.[30/]

In this proceeding, the Commission should establish financial qualification standards that are at least as rigorous as those standards which currently are in effect for the Domestic Fixed-Satellite Service.[31/] Such firm financial requirements are particularly important in this proceeding because of the size of the capital investment required to construct and launch the proposed systems and the need to launch a significant number of satellites before any one system can provide MSS.[32/] The "Elements of a Consensus" plan recognized the important public interest benefit of "[n]o set asides for never-to-be implemented systems."[33/] Ensuring that each applicant has the substantial

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30/ See, e.g., Aeronautical Radio, Inc. v. F.C.C., 928 F.2d 428 (D.C. Cir. 1991); Columbia Communications Corp. v. F.C.C., 832 F.2d 189 (D.C. Cir. 1987).

31/ See Licensing Space Stations in the Domestic-Fixed Satellite Service, 101 F.C.C.2d 223, 233 (1985) ("Fixed-Satellite Service"); see also Amendment to the Commission's Rules to Allocate Spectrum for and to Establish Other Rules and Policies Pertaining to, a Radiodetermination Satellite Service, 104 F.C.C.2d 650, 664 (1986) ("RDSS Licensing Order").

32/ In the past, the Commission has recognized that financial qualifications are necessary to "ensure[] that the orbit-spectrum resource is not tied up by entities unable to fulfill their plans. . . ." RDSS Licensing Order, 104 F.C.C.2d at 663. Financial requirements are especially warranted where "grant of an authorization to an applicant who is not financially qualified is . . . likely to preclude qualified applicants from constructing and operating proposed systems. . . ." Fixed-Satellite Service, 101 F.C.C.2d at 231. In such circumstances, "a strict application of qualification standards will result in the most efficient and expeditious provision of additional domestic satellite services required by the public." Id. at 224.

33/ See Report, at Addendum 1.

financing required to build its proposed system provides the best guarantee that no construction permits will be granted to "never to be implemented" systems.

The Commission should also adopt appropriate technical standards for systems operating in the 1610-1626.5/2483.5-2500 MHz bands in order to ensure that the limited spectrum resource is used in an efficient manner. In particular, the Commission should require that any MSS/RDSS system it licenses provide continuous coverage of the contiguous United States ("CONUS"). As the Commission has stated, the need for MSS is

> predicated upon the statutory demand for universal communication service, and upon the simple fact that satellite service can be ubiquitous . . . . MSS proponents point out that only MSS can provide a service which is truly universal and is not dependent upon geographic location . . . . They further state that MSS can provide high quality service where no service would otherwise exist -- for example, to the 2% of the population of the contiguous United States (CONUS) who live in areas too remote, too rugged, and/or too sparsely populated to justify construction and development of terrestrial systems -- some 5.7 million people.[34]

As a result, the Commission made full and adequate coverage of CONUS a basic qualifying requirement (or, as it said, a "_sine qua non_") for all MSS applicants.[35] A similar standard should be adopted for the proposed RDSS/MSS systems in this proceeding.

34/ Notice of Proposed Rulemaking in Gen. Docket No. 84-1234, _Rules to Allocate Spectrum for, and To Establish Rules and Policies Pertaining to, the Use of Radio Frequencies in Land Mobile Satellite Service for Various Common Carrier Services_, 50 Fed. Reg. 8149 (February 28, 1985), at ¶ 4.

35/ _Id_. at ¶ 46.

Given the scarcity of spectrum available for such systems, the Commission should not award a construction permit or license to any applicant that does not propose to provide full CONUS coverage.

In addition to geographic coverage requirements, the Commission also should establish spectrum efficiency standards to ensure that MSS spectrum will be used in an efficient manner. The Joint Commenters submit that it would not be in the public interest to license an MSS system and assign it spectrum if that system could only accommodate a very small number of users. This is not to say that smaller capacity systems should not have access to any spectrum, but only that all systems should be designed to achieve a certain minimum spectrum efficiency if they are to be licensed in these bands.

2. The Commission Should Adopt Construction and Launch Milestone Schedules and Grant Waivers Only in Exceptional Circumstances

The Commission should use its authority under Section 319(b) of the Communications Act, as amended, to establish construction and launch milestones and require that MSS/RDSS permittees strictly adhere to them. As suggested by the "Elements of a Consensus" plan, permittees that do not meet these milestones would lose their permits, and the related spectrum would then be reassigned to the other operational systems.

Following the Commission's recent proposal in the NVNG MSS proceedings,[36/] the Commission should establish three important milestones. First, each permittee should be required to begin construction no later than _one year_ after the Commission order awarding it a construction permit. Second, each permittee should institute and be required to maintain a construction schedule that would ensure that (i) its first satellite is launched no later than _four years_ after award to it of a construction permit, and (ii) that its entire satellite constellation is launched within _six years_ of its initial permit.[37/] These milestones should be strictly enforced. Any extension of milestone dates should be conditioned on a persuasive showing by the permittee of substantial progress toward completion of the milestone and truly extraordinary circumstances beyond the control of the permittee or its contractors.

36/ Notice of Proposed Rulemaking: _Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile-Satellite Service_, FCC 93-28 at ¶ 23. In that proceeding, the Commission proposed that the first two satellites should be launched within four years since these systems would be capable of providing some non-voice service at that time.

37/ In order to ensure that all permittees are treated fairly, any one system permittee should not be allowed to meet its own milestones by joining with another permittee and sharing satellites or by acquiring ownership of, or by participation in the operations of another permittee.

III. THE JOINT PROPOSAL IS IN THE PUBLIC INTEREST

The joint proposal is in the public interest and a Notice of Proposed Rulemaking incorporating its essential features should be adopted promptly by the Commission for the following reasons:

(1) The joint proposal promotes the development of services responsive to market demand by maximizing multiple entry and ensuring competition among multiple satellite systems, without discriminating in favor of one technology over another.[38]

(2) The joint proposal will make highly efficient use of all of the MSS/RDSS spectrum that the Commission has proposed for allocation.[39]

(3) Adoption of this plan would avoid a finding of mutual exclusivity among the current group of applicants, since all qualified applicants would have an equal opportunity to

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[38] Such an approach to licensing is consistent with the Commission's general policies in the domestic satellite area where licensees are given substantial flexibility in designing their systems. See Assignment of Orbital Locations to Space Stations in the Domestic Fixed-Satellite Service, 3 FCC Rcd. 6972 ¶ 2 (1988); Domestic Fixed-Satellite Service, 88 F.C.C.2d 318 (1981). It is also consistent with the Commission's proposed rules in the non-voice, non-geostationary orbit mobile satellite service ("NVNG MSS") proceeding. See Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile-Satellite, CC Docket No. 92-76, FCC 93-28, at ¶ 7 (released Feb. 10, 1993).

[39] The Joint Commenters believe that a standing committee of representatives of those licensees whose systems are operational would be a useful means of resolving certain frequency assignment matters, such as implementing any periodic adjustment of spectrum assignments among operating systems based upon usage.

receive construction permits and licenses.[40] Such an outcome would serve the public interest by making mobile satellite communications service available to the public at the earliest practicable date, with a minimum of regulatory delay, and in a manner which promotes multiple entry. The plan would also eliminate any possibility that this spectrum could be auctioned to MSS applicants.[41] MSS services that are predominantly designed for worldwide markets, that will use internationally allocated frequencies, and that will require licenses from other

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[40] A comparative hearing is only required where the grant of one bona fide application results in the dismissal of another bona fide application simultaneously pending before the Commission. See Ashbacker Radio Corp. v. FCC, 326 U.S. 327 (1945); see also, Telocator Network of America v. FCC, 691 F.2d 525 (D.C. Cir. 1982) (Need for comparative hearings obviated where Commission indicated that it would award a license to every eligible licensee.)

[41] Title VI of the Budget Reconciliation Act ("Communications Licensing and Spectrum Allocation Improvement") grants the Commission authority to use competitive bidding only when mutually exclusive applications are accepted for filing for any initial license or construction permit. See 47 U.S.C. § 309(j)(1). This legislation specifically recognizes that the Commission shall not be relieved of its "obligation in the public interest to continue to use engineering solutions, negotiation, threshold qualifications, service regulations, and other means in order to avoid mutual exclusivity in application and licensing proceedings." See 47 U.S.C. § 309(j)(6)(E). In the related House Report, it is further noted that

> The ongoing MSS (or 'Big LEO') proceeding is a case in point. The FCC has and currently uses certain tools to avoid mutually exclusive licensing situations, such as spectrum sharing arrangements and the creation of specific threshold qualifications, including service criteria.

Report of the House of Representative's Committee on Energy and Commerce, H.R. 2264 (May 25, 1993).

countries to operate are not good candidates for competitive bidding.[42]

IV. CONCLUSION

The Joint Commenters request that the Commission promptly issue a Notice of Proposed Rulemaking which proposes adoption of rules and regulations incorporating this joint proposal for licensing the current group of applicants.[43] This step will allow all other interested parties to comment on the proposed rules and regulations in the shortest possible time. In addition, the Commission should adopt the MSS allocations

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[42] Spectrum auctions could establish an unfortunate precedent that could trigger a wave of auctions in other countries, and thereby dramatically increase the implementation costs of a global system. A further negative consequence of auctions would be the potential harm to U.S. competitiveness created by imposing costs on U.S. licensees not borne by their international competitors, and by enhancing the potential for similar payment schemes in other countries that could be used to discriminate against U.S. systems (e.g., auctions could be applied to privately-owned but not state-owned systems). Such repercussions could place U.S. licensees at a serious competitive disadvantage. Finally, auctions could undermine the coordination process for international MSS systems.

[43] At the same time, the Commission should propose any other licensing, technical and service rules that it deems to be in the public interest. For example, there were several rules and regulations recommended by the Committee in its report. See Report, at 35-50.

proposed in this proceeding and continue the parallel processing of the pending applications.

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Appendix A

Maximizing Use of the 1610 - 1626.5 MHz Band for MSS while Protecting GLONASS and GPS, Aeronautical Radionavigation and Related Spaceborne Navigation Aids

October 6, 1993

1.0 Purpose of the Appendix

The purpose of this Appendix is to provide information to guide the FCC in the development of rules for use of the 1610-1626.5 MHz band by the Mobile Satellite-service (MSS) that will maximize the usefulness of this band for MSS while providing protection to GLONASS and GPS, aeronautical radionavigation and related spaceborne navigation aids. Significant historical and technical background is presented. There are two major thoughts to be conveyed by this appendix: 1) that the GLONASS system is planning to adopt a new Frequency Management Plan which should resolve many of the sharing issues discussed herein, and 2) even if GLONASS does not modify its frequency plan MSS applicants believe that MSS systems can operate down to 1610 MHz and allow other services to meet their service objectives.

1.1 Proposed Actions for the FCC

In order to enable MSS systems to proceed with certainty concerning the ability to utilize the entire 1610-1626.5 MHz band, the FCC should take the following actions:

1) Adopt the entire 1610-1626.5 MHz band on a primary basis for MSS. As discussed in this filing, the entire band is required to accommodate the multiple MSS system applicants, to enable these systems to obtain financing, and to construct and operate systems which will provide capacity needed to ensure adequate service.

2) Adopt the uplink e.i.r.p. density values for mobile earth stations (MESs) recommended by WARC-92 and contained in part in Footnote 731E of the Radio Regulations as follows:

> *A mobile earth station operating in either the of the services in this band shall not produce an e.i.r.p. density in excess of -15 dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. 732, unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, a value of -3 dB(W/4 kHz) is applicable.*

3) Not adopt the final sentence of Footnote 731E which creates ambiguity about the status of MSS vis a vis stations in the aeronautical radionavigation service and GLONASS. This last sentence Footnote 731E reads:

> *Stations of the mobile satellite service shall not cause harmful interference to, or claim protection from, stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of the No. 732 and stations in the fixed service operating in accordance with the provisions of No. 730.*

4) Work within the Interdepartment Radio Advisory Committee (IRAC) to obtain the support of other U.S. government agencies concerning the development of a U.S. proposal to the Russian administration to modify the GLONASS system so that it operates below 1610 MHz. This effort would support present efforts by the Russian Federation to revise the GLONASS Frequency Plan. (See the Attachment to Appendix A)

5) Work within the U.S. government to encourage the development by the aviation community of interference protection criteria for the Global Navigation Satellite System (GNSS) which takes into account both the Global Positioning System (GPS) and GLONASS as components of that system. The objective should be to develop a protection criteria that would be applied to the use of GNSS by commercial aviation, rather than a protection criteria that assumes only one system, GPS or GLONASS, is in use. In developing such protection criteria, the ability to utilize all the satellites in both systems, with the resulting improvement in the number of satellites visible with adequate geometries must be taken into consideration.

6) Based on the outcome of the activities regarding development of appropriate protection criteria for GNSS receivers on-board commercial aircraft, the Commission can adopt MES out-of-band emission limits on for protection of GPS and GLONASS. Such limits need not be adopted at the time the FCC adopts the MSS allocation at 1610-1626.5 MHz. Because the future operational status of GLONASS is currently unknown, the adoption of any limits other than those generally applicable in the Commission's rules would be premature. Adoption of MES out-of-band emission limits for GPS protection should be deferred pending consideration of the establishment of protection limits for the GNSS.

2.0 Background

2.1 History of Allocations in the 1610-1626.5 MHz Band

2.1.1 Allocation situation prior to 1987

The band 1610-1626.5 MHz, prior to the 1987 Mobile WARC, was allocated on a primary basis to aeronautical radionavigation. In addition, a number of international footnotes were (and continue to be) applicable to the band. The more relevant of these footnotes are:

(1) Footnote 730 which provides an additional allocation to the fixed service on a primary basis in Germany, Austria, Bulgaria, Cameroon, Guinea, Hungary, Indonesia, Libya, Mali, Mongolia, Nigeria, Poland, Rumania, Senegal, Czechoslovakia and the Former Soviet Republics;

(2) Footnote 731 which provides an alternative allocation, in Sweden, to the aeronautical radionavigation service on a primary basis;

(3) Footnote 732 which states that the band 1610-1626.5 MHz is reserved on a worldwide basis for the use and development of airborne electronic aids to air navigation and any directly associate ground-based or satellite-borne facilities, subject to Article 14 coordination; and

(4) Footnote 733 which provides that the band is allocated to the aeronautical mobile-satellite (R) service on a primary basis subject to agreement obtained under the procedure set forth in Article 14.

Footnote 732 was adopted to provide for the implementation of the Russian-planned GLONASS system, which was similar in mission to the U.S. Department of Defense (DOD) GPS system. The allocation for the U.S. GPS system is encompassed by the co-primary allocations to aeronautical radionavigation and radionavigation-satellite (space-to-Earth) for the 1559-1610 MHz band.

The Russian administration (at that time the USSR), in 1983, advance published the characteristics of the GLONASS system, for the purpose of accomplishing Article 14 coordination (See Advance Publication in Special Section AR11/A/3, June 8, 1982 and Request for Agreement in Special Section AR14/C/8, April 19, 1983). The GLONASS frequencies identified for coordination were 1610-1617 MHz. (Note: The system operates on frequencies down to 1602 MHz but these were not required to be coordinated pursuant to Article 14). Despite the fact that radioastronomy operations (at that time a secondary allocation) were considered to be at risk from GLONASS transmissions, the Russian administration successfully coordinated the system pursuant to Article 14 which requires affirmative consent of all affected administrations.

2.1.2 The 1987 Mobile WARC

In 1987 the United States sought, and achieved, at WARC-MOB-87, a primary allocation in Region 2 for the Radio-determination Satellite Service (RDSS). A secondary allocation was obtained in Region 3 and by footnote, on a secondary basis in Region 1. The United States succeeded in obtaining the allocation for RDSS by demonstrating that, at the proposed e.i.r.p. density for systems which might operate in that service, no harmful interference would be caused to other services in the band, including the GLONASS system, operating pursuant to Footnote 732 and the successful Article 14 coordination. However, no density trigger value was adopted which would apply to RDSS in the band 1610-1626.5 MHz.

2.1.3 WARC-92

At WARC-92 the United States sought to expand the allocation for RDSS to primary in all three regions and to obtain a co-primary allocation for Mobile-satellite service (MSS) in all three regions. The United States succeeded in these efforts, through willingness to adopt Footnote 731E which provides for a e.i.r.p. density trigger value in the part of the band in which GLONASS operates (up to 1617 MHz), an absolute e.i.r.p. density limit in the band above GLONASS (1617-1626.5 MHz), and acceptance of the provision in Footnote 731E which provides that "(S)tations of the mobile-satellite service shall not cause harmful interference to, nor claim protection from, stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. 732 and stations in the fixed service operating in accordance with the provisions of No. 730." Interestingly, while the e.i.r.p. densities were made applicable to both RDSS and MSS, the final sentence of Footnote 731E is applicable only to MSS stations. This portion of the footnote was added to provide protection to a Swedish radar system and to fixed stations operating in the countries listed in Footnote No. 730.

The reference to stations operating in accordance with No. 732 refers to the portion of the GLONASS system which had been successfully coordinated pursuant to Article 14. This language with respect to GLONASS, could be considered superfluous because of the specification of the uplink e.i.r.p. densities in the other part of Footnote 731E. The e.i.r.p. density values were developed at WARC-92 in conjunction with members of the Russian delegation who felt that these values would be sufficient to protect GLONASS receivers onboard aircraft in flight.

Also at WARC-92, the band 1610.6-1613.8 MHz was adopted on a primary basis for the radioastronomy service in all three ITU regions. This additional co-primary allocation introduces an addition complicating factor into the issue of how MSS can make the maximum use possible of the 1610-1626.5 MHz band.

2.2 Comments on the Current Status of 1610-1626.5 MHz for MSS

The original purpose of Footnote 731E was to provide reassurance to the administrations with specific systems in the band (Sweden and Russia) that MSS systems would not cause them harmful interference. In the case of Sweden, the systems involved are radar systems of limited geographic scope. In the case of Russia, the system encompassed by Footnote 732 is the

GLONASS system operating in the 1610-1617 MHz band as coordinated under Article 14 of the Radio Regulations.[1]

During the Above 1 GHz Negotiated Rulemaking (NRM), analysis indicated that the Swedish radar system would not be adversely affected by MSS.[2] However, with regard to the GLONASS system, the Advisory Committee reported to the FCC that operations at the uplink e.i.r.p. density value recommended by WARC-92 in Footnote 731E (-15 dBW/4 kHz) could interfere with receipt of GLONASS signals by receivers operating in the same vicinity as an MES. At the present time, the international aviation community is considering the use of both the U.S. DOD-funded GPS and GLONASS for navigation, including possible use for gate-to-gate navigation. The aviation community believes that use of both of these systems is needed to provide it with the level of integrity of navigational data it requires to use satellite systems for "sole means" navigation. The aviation community seeks protection for GLONASS and GPS receivers at distances as close as 100 meters to the receiver.

One of the difficulties faced in reconciling the stated protection requirements of aviation with the revisions to the Radio Regulations adopted at WARC-92 is the fact that the aviation community has continued to enlarge its vision for the expected role that GLONASS and GPS will play in aeronautical navigation. From a position of rejecting the notion of reliance on satellite-based navigational systems (as recently as one or two years ago), the aviation community is now moving towards the adoption of a policy that satellite-based navigation, e.g., the GNSS, will be used as a "sole means" navigation system. This heightened role for these systems has led to aviation seeking extremely stringent protection criteria for GLONASS and GPS receivers which will be operated on-board aircraft.

2.3 GNSS Operations

The combined GPS and GLONASS systems are part of the GNSS which the aviation user community seeks to use for en route, oceanic, terminal, and approaches. The aviation community envisions that the GNSS may eventually provide the sole means of aeronautical navigation from gate to gate

2.4 Radio Astronomy Allocation

The band 1610.6 to 1613.8 MHz was upgraded at WARC 92 to a primary allocation to the Radio Astronomy service (RAS) on a world wide primary basis and is shared with primary allocations for RDSS/MSS uplinks and the aeronautical radionavigation service (ARNS). It is used at RAS observatories to observe the spectral line of the hydroxyl molecule near 1612 MHz which is considered by radio astronomers to be among the most important lines below 275 GHz. The upper and lower band limits correspond to the maximum expected "blue shift" and "red shift" to these lines due to relative motion of the galactic sources. This RAS band is presently protected by ITU Radio Regulations (RR) 733E and 734.

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[1] Article 14 of the Radio Regulations provides the procedures for coordination of systems when affirmative agreement of other administrations must be obtained.

[2] The report of Drafting Group 2C (Sharing with Services other than Aeronautical Radionavigation and Radioastronomy) concluded that, "Swedish radars operating in the L-band, because of their sparse locations and pulsed operations, will not cause harmful interference to MSS operators with well designed receivers, nor will MSS operations interfere with them." Report of Drafting Group 2C to IWG-2 of the MSS Above 1 GHz Negotiated Rulemaking Committee, at p. 3.

GLONASS had been coordinated to operate in the 1610 to 1617 MHz portion of the 1610 to 1626.5 MHz band prior to a primary allocation being adopted for the RAS. Since that time GLONASS satellites have begun to transmit and according to the radio astronomy community about 80 percent of their measurements have been voided due to GLONASS interference. In 1992 the GLONASS and the radio astronomy communities conducted a joint experiment to evaluate the level of interference. The results of the experiment have been summarized and suggestions presented on revising the GLONASS frequency plan in an ITU Radiocommunication Working Party Document 7D/TEMP/17-E, 5 April 1993.

2.5 MSS Operations

The United States sought co-primary allocations for MSS in the 1610-1626.5 MHz and 2483.5-2500 MHz bands to accommodate the requirements evidenced by the six (five non-geostationary, one geostationary) system applications filed before the FCC. Accommodating even a portion of these systems necessitates the full availability of the 1610-1626.5 MHz band, without undue constraints caused by the need to protect other services. The MSS industry is one in which the United States has dominance -- in the construction of satellites, the manufacture of handsets, and the development of sophisticated software to operate these complex systems. The demand for MSS is evident in the dramatic growth in demand for mobile communications of all types.

Enabling these systems to utilize the 1610-1626.5 MHz band to the fullest extent feasible is necessary to ensure that the systems can obtain financing and can serve the targeted markets. The United States can have pre-eminence in the satellite cellular market worldwide, can benefit economically and through job creation, subject to the full availability of this band. Continued delay in the resolution of this proceeding as well as uncertainties as to the full availability of the 1610-1626.5 MHz band will only serve to enable multi-administration systems, such as INMARSAT, and non-U.S. operators to gain a valuable monopoly in this market.

3.0 Statement of the Problem

The FCC must take a leadership role in resolving the conflict between the operation of MSS and ARNS in the 1610-1626.5 MHz band. The key actions the Commission should undertake are outlined at the beginning of this paper. In resolving the current proceeding, the Commission must adopt the e.i.r.p. density values contained in Footnote 731E. That is all that is required within the current proceeding.

Recent developments concerning agreements reached between Russia and Australia and Russia and Japan concerning the coordination of GLONASS-M, indicate that the resolution of coordination issues between MSS and GLONASS, may be at hand. These agreements, obtained to protect radioastronomy, specify that GLONASS will operate no higher than 1608 MHz by 1998. Such action would resolve most of the issues relating to coordination of MSS with the GLONASS system. The remaining issue would be the development of out-of-band emission limits for services operating in bands adjacent to GLONASS. This would apply to MSS systems operating in the 1610-1626.5 MHz band.

Prior to proceeding with attempting resolutions of coordination of MSS and GLONASS, the following should be considered:

- The Aeronautical Radionavigation, Radio Astronomy and Mobile Satellite Services share common portions of the 1610 to 1626.5 MHz band on a co-primary basis.

- The aviation community has proposed protection criteria to separately protect GPS and GLONASS from interference in terms of EIRP density limits from MES operating in MSS systems.

- The MSS community has relied on RR 731E as developed during WARC 92 to provide protection for ARNS in terms of the MES EIRP density limit.

- During both the recently concluded NRM and the current United States Study Group (USSG) Working Party 8D meeting, there were several discussions as to protection levels for GPS and/or GLONASS receivers. The aviation community and the MSS community could not reach a combined agreement.

There is interest in the United States in using both GPS and GLONASS as part of the GNSS. A necessary objective must be to develop a protection criteria that would be applied to the use of GNSS by commercial aviation on a system basis, and not just to individual segments of GNSS, such as, a GPS and/or GLONASS receiver. To date the protection criteria proposed by the aviation community appears to provide protection to a GPS/GLONASS receivers for all 20 ms observations for all GPS/GLONASS receivers at anytime, anywhere in the United States. Clearly what is needed is to develop a protection criteria with consideration to utilizing all the available satellites from both GPS/GLONASS constellations in the GNSS. The number of visible satellites with the required geometries with respect to the GNSS receiver site should be analyzed as to providing the desired accuracy, redundancy and system integrity to meet the needs of the aviation community. The protection criteria should be developed based upon the GNSS system level requirements, and not on one corrupted observation at a GPS or GLONASS receiver from one of many satellites. The frequency range over which the protection criteria is to be applied must also be clearly stated and validated. Requiring protection over a frequency allocation band and not just the operating band, is unreasonable and does not provide needed spectrum to co-primary systems. Also, the uncertainties in the GLONASS implementation schedule and frequency plan plus the GLONASS system viability into the 21st century are major unknowns. A proposed manner in which this protection criteria definition problem can be resolved is presented in paragraph 4.7.

4.0 Joint Position Relative to Usage of the 1610 - 1616 MHz Band

Both Motorola and LQSS plus others have studied the problem and concluded that the entire MSS band from 1610 to 1626.5 MHz is available and should be allocated to MSS operations.

4.1 MSS Is a Primary Allocation and Aviation Must Adjust

WARC '92 allocated spectrum to MSS operations in this band and established coordination criteria. (i.e., the -15 dBW/4 kHz EIRP density). At the same time Radio Astronomy was upgraded to Primary Status. Taken together the still to be deployed GNSS system should adjust its requirements to come into a sharing arrangement with MSS and Radio Astronomy.

4.2 Consensus in the NRM Was Reached Only for GPS Protection

<u>During the NRM there was general agreement to protect GPS from MES unwanted emissions only in the narrow 2 MHz C/A code bandwidth.</u> Specifically, the committee recommended that mobile units which operate with MSS systems utilizing any portion of the 1610 to 1626.5 MHz band should limit their out-of-band emissions so as not to exceed an EIRP density of -70 dBW/1 MHz (or -94 dBW/4 kHz if uniform over the 1 MHz band) averaged over any 20 ms period in any portion of the 1575.42 ± 1.023 MHz band for broadband noise emission. For any dis-

crete spurious emissions in the same band, i.e., bandwidth less than 600 Hz, the EIRP should not exceed -80 dBW. It should be noted that these levels were agreed upon due to the fact that GPS operates about 35 MHz away from the closest MSS carrier just above 1610 MHz and that the requested protection was for only a narrow band. This protection criteria specified in terms of an unwanted emission in the GPS operating band from a MES unit operating in an MSS environment is significantly higher than known or proposed unwanted emission specifications (ETSI, CCIR, FCC, etc.) for similar MES units (Refer to para 4.5)

<u>There was no general agreement to protect GLONASS from either in-band or out-of-band emissions.</u>

4.3 GNSS Can Accommodate MSS and Still Meet Its Requirements

There are several techniques that may be used to accommodate MSS and still meet the requirements of the aviation community using GNSS.

- There is evidence that the Russian GLONASS system will modify their existing frequency plan with a likely result that GLONASS satellites will only transmit signals below 1610 MHz (See the Attachment in Appendix A). A detailed discussion of several alternative GLONASS frequency plans is presented in an existing USSG Working Party 8D Document 8D-49(Rev.1), September 9, 1993. This paper is jointly sponsored by Motorola and LQSS. Discussions are provided on alternative frequency plans that describe frequency reuse on anti-podal satellites (those on opposite sides of the earth). This concept has been discussed in the past. Implementation of reduced bandwidth operation is also reported to potentially reduce GLONASS receiver cost which would be a benefit to the aviation community.

- Protection levels discussed at the NRM are excessive for high quality avionics manufacturing of receivers.
  First, the signal levels received from the direction of an earth located MES operating near an airport will be mitigated by the aircraft fuselage blockage. Boeing Aircraft Company measurements of antennas show that the reception of signals from typical MES units beneath an aircraft (overflight condition) will be reduced by a factor of nearly 30 dB.
  Second, the rejection of unwanted signals could be better than those considered in the current ARINC specification. Narrower band filters with sharper rolloff characteristics could provide improvement.
  Third, the MSS industry and the aviation community, primarily ARINC and the FAA, will be developing a joint plan to measure the performance of GLONASS receivers. The purpose of this effort will be to establish protection limits for GLONASS in terms of MES EIRP density levels, guardbands, and associated geometries as a function of typical and/or available MES equipments from all participating MSS system applicants. The GLONASS receiver manufacturers would provide their best available prototypes for the test program. They would be requested to provide prototype modifications to their equipment to evaluate concepts such as specialized filters, etc. It is anticipated that initial testing would be static bench testing of equipments. Dynamic testing with aircraft and typical GLONASS antennas could be implemented, if required.

- Even if the GLONASS system is not modified, there are sufficient GPS and GLONASS satellites to provide protection from effects of interference to provide at least 5 GNSS satellite measurements of sufficient quality that would not affect the position accuracy during an approach, even assuming that two of the GPS satellites are out of service, and all of the GLONASS satellites above 1610 MHz are out of service. During the NRM LQSS provided analysis that the minimum 5 satellite condition existed for only 14 minutes out of a 51 day period. The average number of GNSS satellites in view at a mid-CONUS site was 9.5 satellites.

4.4 GLONASS Has Status Only Through Article 14 Coordination

As discussed in 2.1.1 above, the GLONASS system operates pursuant to Footnote 732 which requires Article 14 coordination. Article 14 coordination requires affirmative consent of other administrations. The use of GLONASS, as an essential component of the GNSS, has led to the development of very stringent protection criteria on the part of aviation. In addition, this protection criteria considers the potential interference to the signal being received from a single GLONASS satellite, rather than interference to receipt of GLONASS signals from multiple satellites, or even more appropriately, interference to receipt of signals from both GPS and GLONASS satellites.

To understand why consideration should be given to interference on a system-wide basis, the following describes navigation using GPS and/or GLONASS, as contained in the Report of Informal Working Group 2 of the MSS Above 1 GHz Negotiated Rulemaking Committee as follows:

> *The user segment will consist of antennas and receiver-processors that provide positioning, velocity and precise timing to the user. The GPS/GLONASS receiver automatically selects appropriate signals from four of the satellites in view based upon optimum satellite-to-user geometry. It then solves time-of-arrival difference quantities to obtain distance between user and satellites. This information establishes the user position with respect to the satellite system. A time correction factor then relates the satellite system to earth coordinates. User equipment measures four independent pseudo-ranges and range rates and translates these to three-dimensional position, velocity and system time.*[3]

On September 14, 1993, a test of the U.S. GPS system was conducted by a civilian aircraft. The test demonstrated that the aircraft could be navigated and landed, using only navigational direction from four satellites of the GPS system. See, "A Record Flight: Satellites Steer a Civilian Plane," New York Times, September 15, 1993. Dave Hinson, the head of the Federal Aviation Administration, called the GPS system "one of the most important advances in the history of aviation navigation."

However, despite the fact that signals from four satellites in appropriate geometries can supply precise navigational information, the aviation community has stated the desire for even more satellites in view to attain what it terms " desired availability." RTCA, Inc. (Radio Technical Committee for Aviation) states that:

> *(I)n order to assure the integrity*[4] *of navigational data from GNSS, RTCA has specified that a minimum of 5 satellites in appropriate geometry must be continuously in view to obtain an availability*[5] *of 99.999%.*[6]

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[3] Report of Informal Working Group 2 (Inter-service Sharing Issues to the MSS Above 1 GHz Rulemaking Committee, April 6, 1993, at p. 2.

[4] "Integrity" is defined by RTCA as "the assurance that all functions of a system perform within operational performance limits." RTCA Task Force Report on the Global Navigation Satellite System (GNSS) Transition and Implementation Study, Appendix B, p. 4.

[5] RTCA defines "availability" as "the percentage of time that the services of the system are within required performance limits. Availability is an indication of the ability of the system to provide usable service within the specified coverage area. Signal availability is the percentage time of time that navigational signals transmitted from

In order to enhance the probability of attaining the availability sought by aviation, RTCA recommends that aviation use both the GPS and GLONASS system for navigation.[7] The United States Federal Aviation Administration has not yet formally endorsed the reliance on both GPS and GLONASS.[8]

4.5 The FCC Should Not Impose More Stringent Requirements on MSS to Protect GNSS than Requirements Imposed on Other Services

MSS is a primary service and should not be subjected to unreasonable requirements such as imposing higher levels of protection than it now gets from other adjacent band services. For example, a partial listing of the allowable levels of spurious and noise output for INMARSAT Standards-M, B and Aeronautical Earth Stations (AES) as published in the INMARSAT System Definition Manuals are defined below:

The unwanted emissions (excluding harmonics) radiated by the MES or AES in any 4 kHz band shall fall below the spectrum envelope defined by the following data points.

<u>INMARSAT-M</u>

MES CLASS	Frequency (MHz)	EIRP (dBW/4 kHz)
Maritime and Land	<1530	-60
Mobile	1616.5	-55

<u>INMARSAT-B</u>

MES CLASS	Frequency (MHz)	EIRP (dBW/4 kHz)
24 and 132 kbits/s	<1530	-60
Transmitters	1611.5	-55

<u>AES</u>

The defined harmonic and spurious output relative to the EIRP of the carrier shall not exceed -55 dBc, or [-37 + 10 log (carrier power in watts)] dBc, whichever is the lower level, for the nominal EIRP range of 25.5 to -4.5 dBW over the frequency range of 1559 to 18000 MHz. This results in an EIRP density of about -60 dBW/4 kHz, similar to INMARSAT-M and B.

In summary, INMARSAT-M and -B emission levels are about 40 dB higher than the emission levels that the aviation community is trying to impose on the LEO MSS community operating in the 1610-1626.5 MHz band. MES equipments used in MSS systems should only be re-

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external sources are available for use. Availability is a function of both the physical characteristics of the environment and technical capabilities of the transmitter facilities." <u>Supra</u>., Appendix B, p. 2.

[6] <u>Report of Informal Working Group 2</u>, p. 19, citing the <u>RTCA Task Force Report</u>.

[7] <u>RTCA Report</u>, p. 2.

[8] <u>See 1992 Federal Radionavigation Plan</u>, published jointly by the Department of Transportation and the Department of Defense, January, 1993. The <u>Plan</u> does state,, however, that "(O)pportunities exist to develop receiver avionics which combine two radionavigation signals, such as, GPS/Loran-C, GPS/GLONASS, GPS/Omega, and GPS//VOR/DME, and thereby significantly improve user navigation performance." at p. 4-12.

quired to meet emission levels comparable to those of INMARSAT and not levels approaching -94 dBW/4 kHz.

4.6 The FCC Should Work Within IRAC to Obtain Government-wide Cooperation Which Will Facilitate Use of the 1610-1626.5 MHz Band by MSS

Because a portion of the 1610-1626.5 MHz band is currently used by GLONASS, a system which may be used by aviation for important navigation functions, and because the 1610-1626.5 MHz band is allocated on a co-primary basis to MSS, RDSS, Radioastronony (1610.6-1613.8 MHz), and aeronautical radionavigation, several government agencies must be involved in developing policies which will facilitate use of the band by commercial MSS and RDSS systems. The FAA is involved because of its interest in aeronautical navigation systems and because of the co-primary allocation to aeronautical radionavigation. The DOD has concerns because of the need to protect GPS and of the potential that GPS and GLONASS will be used in conjunction for civilian navigation functions. NTIA also is involved through the Interdepartment Radio Advisory Committee, which manages spectrum for U.S. government agencies.

The FCC must take an affirmative position within IRAC that MSS and RDSS, in order that they may utilize the primary allocation in 1610-1626.5 MHz and enable the U.S. MSS/RDSS systems to go forward, should not be subjected to unreasonable constraints vis a vis GLONASS or other possible aeronautical radionavigation systems in the band. The FCC should work with NTIA and other concerned government agencies to develop a common position that the GLONASS system should be moved sufficiently below 1610 MHz to enable MSS/RDSS to make full use of the band. In addition, a common understanding that GNSS is to be protected (and not single GLONASS satellites) should be developed. With this understanding, out -of-band emission limits on MSS/RDSS can be developed which will protect GPS and GLONASS, without unduly constraining MSS/RDSS systems. Constraints on services, such as MSS, should not be imposed in order to protect GLONASS receivers with wide open front ends lacking interference rejection or other performance parameters which are not consistent with a goal of reducing interference susceptibility. The FCC is encouraged to request studies of minimum operational standards for an "interference resistant" GNSS receiver.

5.0 Supporting Technical Discussions

The technical analyses in this section provide logic and understanding as to why the stated position on sharing with GLONASS in the previous sections are reasonable and valid.

5.1 MSS Needs the Full 16.5 MHz Uplink Band for Viable Operation

Enabling MSS systems to utilize the 1610-1626.5 MHz band to the fullest extent feasible is necessary to ensure that the systems can obtain financing and can serve the targeted markets. The United States can have pre-eminence in the satellite cellular market worldwide, can benefit economically and through job creation, subject to the full availability of this band. Continued delay in the resolution of this proceeding as well as uncertainties as to the full availability of the 1610-1626.5 MHz band will only serve to enable multi-administration systems, such as, INMARSAT, and non-U.S. operators to gain a valuable monopoly in this market.

5.2 GPS Operations Will Be Unaffected by MSS Operations

During the NRM it was generally agreed upon that MSS operators would protect users of the GPS C/A code. This would be accomplished by controlling MES EIRP unwanted emissions in the narrow GPS operating band at 1575.42 MHz. However, any significant changes in proposed protection criteria might affect MSS operators' ability to meet any new requirements. It should be noted that these levels were agreed upon due to the fact that GPS operates about 35 MHz away from the closest MSS carrier just above 1610 MHz and that the requested protection was for only a narrow band. This protection criteria specified in terms of an unwanted emission in the GPS operating band from a MES unit operating in an MSS environment is significantly higher than known or proposed unwanted emission specifications (ETSI, CCIR, FCC, etc.) for similar MES units (Refer to para 4.5)

5.3 GLONASS Operations Currently Make 80% of Radio Astronomy Observations Unusable

The current operation by a partial constellation of GLONASS satellites has rendered 80% of the measurements by the Radio Astronomy community unusable in the 1610.6 and 1613.8 MHz band. Therefore, the Radio Astronomy community has been working to gain a resolution of this problem in the band between 1610.6 and 1613.8 MHz. Protection levels requested by the radio astronomy community during the NRM are a spectral power flux density of -238 dBW/m^2/Hz. Typical downlink transmissions from GLONASS satellite arrive at airborne receivers at a power level of about -160 dBW for the C/A code. This translates to a spectral power flux density of about -195 dBW/m^2/Hz across the center 1 MHz of the spectrum. Thus, these GLONASS downlink emissions in the RAS band are 43 dB higher than the requested protection level. Transmissions from multiple GLONASS satellites plus GLONASS P code transmissions only exacerbate the problem.

5.4 GLONASS Operation below 1610 MHz Is Possible and Probable

The solution to both the Radio Astronomy interference situation and the MSS operation across the entire 1610 - 1626.5 MHz band is (as described in the NRM comments) for the US government to work to have the GLONASS system operate below the 1610 MHz band edge. This method of operation is not only possible but practical. Recent tests between GLONASS and Radio Astronomy indicate that locating GLONASS carriers below 1605.5 MHz significantly improves the ability of radio astronomers to make their desired measurements.

GLONASS operation below 1610 MHz is facilitated by operating the GLONASS system in a two times frequency reuse pattern on a constellation wide basis. The satellites at anti-podal locations would each transmit on the same frequency. This method requires about half the existing GLONASS RF bandwidth. Since half of the GLONASS satellites operate below 1610, it is obvious that a GLONASS GNSS receiver equipped to receive signals below 1610 MHz will receive the same number of satellites as with operation both above and below 1610 as is presently conceived.

Operation below 1610 MHz should not degrade the Russian usage of the GLONASS system since the anti-podal satellites cannot be received at locations on opposite sides of the earth for ground and low altitude users. The Russian government has reported that operations may be impacted for GLONASS receivers on-board Russian satellites. This case has been reported to have been analyzed by the Russian GLONASS operators with the result that the problem is solvable. It was determined that the Russian Satellite receivers may discriminate between two GLONASS satellites transmitting on the same frequency by the Doppler shift differences between them.

Recent communications among the Radio Astronomy Community [Dr. Robinson of Australia] indicate that the Russian government plans to operate its satellite system on frequencies below 1610 MHz. The Attachment in Appendix A is a copy of such a correspondence distributed at a recent USSG Working Party 8D meeting.

5.5 Frequency Reuse by GLONASS below1610 MHz Is a Benefit to the Aviation Community

The potential revision to the GLONASS frequency plan to operate below 1610 MHz is a net benefit to the Aviation community as well as the radio astronomy and MSS communities. The receiver RF bandwidth is reduced, the number of channels that the receiver must search for is divided in half, and interference from other services is reduced. The narrower GLONASS operating bandwidth may also allow for a lower cost receiver design.

5.6 Operation below 1610 MHz Will Reduce Interference from Fixed Services Operating in the 1610 - 1626.5 MHz Band

The band above 1610 MHz is largely empty of fixed services, however, in certain portions of the world, such as Sweden, high power radar emissions will radiate in the direction of airborne aircraft. Effects on aircraft using GLONASS receivers over Northern Europe from these high power radar emissions in the 1610-1616 MHz band would be reduced if the GLONASS frequency plan were to relocate below 1610 MHz.

5.7 The Current Status of Aviation Receiver Development Is Such That Changes Can Be Made Now and Not Materially Affect the Worldwide Deployment of the System

The current status of the GNSS receivers is that a few prototypes exist. Early resolution of this issue will allow the US GNSS receiver manufacturers to proceed without delay.

5.8 Band Edge Performance and Required Protection below 1610 MHz

Reasonable GLONASS protection levels consistent with existing and proposed standards (ETSI, CCIR, FCC, etc.) and possibly reasonable protection zones surrounding airports will serve to allow minimal guard band requirements at the 1610 MHz band edge. Guardbands may be different for each RDSS/MSS system depending upon the choice of modulation and transmission parameters. However, if GLONASS carriers are located below 1605.5 MHz, as recommended by radio astronomy, or even lower, and protection is afforded GLONASS only in its nominal 1 MHz band center for each carrier, then an initial guardband of 4 MHz will be afforded to MES units operating just above 1610 MHz. This will greatly increase the probability of RDSS/MSS systems meeting reasonable criteria to protect GLONASS.

5.9 Interoperability of Avionics Quality GLONASS Receivers and MSS Systems

The following items represent areas for further analysis. These analyses should be jointly coordinated and monitored by the aviation community and the MSS system operators.

- Analysis of .....Even if the GLONASS system is not modified, there are sufficient GPS plus GLONASS satellites to provide protection from effects of interference to provide at least 5 satellite measurements of sufficient quality that would not affect the position accuracy during an approach, even assuming that two of the GPS satellites are out of service, and all of the GLONASS satellites above 1610 MHz are out of service.

- Analysis of ......The definition of "harmful interference in footnote 731E should refer to effects of degradation of performance of a system utilizing a constellation of position location service satellites ... i.e. the inability of the receiver to gather a sufficient quantity of usable signals to derive a position location..... not the interference to a single satellite. The operational characteristics of the GLONASS system should be considered.

- Analysis of ..... Furthermore, the degradation in performance should be referenced to high quality avionics equipment which operate with good interference rejection characteristics, to receivers with adequate out-of-band rejection filter performance and to systems which are mounted on aircraft such that sufficient isolation due to fuselage blocking as well as antenna designs which help reject signals from interference from the horizon and below. Very low cost aviation GLONASS receivers with wide open front ends that have no interference rejection should not be allowed as well as antenna mounting and performance which does not take into account interference criteria

- Analysis of ..... MSS is a primary service and should not be subjected to unreasonable requirements such as imposing higher levels of protection than it now receives from services operating in adjacent band. For example, INMARSAT standard M and B systems operating in the lower portion of the Land Mobile Satellite Service (LMSS) band at just above 1626.5 MHz according to INMARSAT Systems Definition Manuals allow for EIRP densities of -55 dBW/4 kHz are expected in the band from 1600 - 1616 MHz. This means that the -70 dBW/1 MHz (or -94 dBW/4 kHz) proposed requirement imposed by the aviation community on RDSS/MSS systems is excessive by 34 dB or a factor of 2500.

6.0 Current Status of GNSS, GPS, and GLONASS

6.1 GNSS

As discussed previously, the GNSS is viewed as encompassing both the GPS and the GLONASS systems, as well as other data sources,[9] with the desired objective of providing a "sole means" navigation system for commercial aviation, including en route, take-off and landing plus ground maneuvers. However, this vision of GNSS has not been adopted, either in the United States or elsewhere. Within the U.S., only GPS is currently considered to be an essential satellite component of the GNSS.[10]

Other administrations have voiced concerns about relying on the GPS system, since the U.S. government can control the degree of accuracy of the system and actions of the U.S. Congress will determine whether the GPS will continue to be funded and replenished over the years to come. The U.S. Federal Radionavigation Plan itself states that any decision to discontinue

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[9] See RTCA Task Force Report on the Global Navigation Satellite System (GNSS) Transition and Implementation Study, RTCA, Inc., September, 1992, which states, at p. 13, that "(B) ecause GNSS is a mix of several data sources -- GPS, GLONASS, probably other satellites and various space aircraft and terrestrial augmentations -- it will be robust."

[10] See 1992 Federal Radionavigation Plan, published jointly by the Department of Transportation and the Department of Defense, January, 1993. The Plan does state,, however, that "(O)pportunities exist to develop receiver avionics which combine two radionavigation signals, such as, GPS/Loran-C, GPS/GLONASS, GPS/Omega, and GPS//VOR/DME, and thereby significantly improve user navigation performance." at p. 4-12.

Federal operation of the existing [radionavigation] systems will depend upon many factors including: "(a) resolution of GPS accuracy, coverage, integrity, and financial issues . . . ".[11]

The international aviation community, through the International Civil Aviation Organization (ICAO), will need to determine the extent to which a GNSS will be utilized for "sole means" navigation, and the elements of a GNSS. In summary, the development and reliance on a GNSS which will encompass both GPS and GLONASS, along with other enhancements, such as differential GPS, other ground-based systems, and other satellites, is not yet fully established.

6.2 GPS

The full constellation of 24 GPS satellites is currently operational. GPS consists of 24 satellite positions with four satellite positions in each of six 55 degree inclined equally space orbital planes. Each satellite will transmit the same two frequencies for navigational signals. The navigational signals are modulated with a predetermined bit stream, containing coded ephemeris data and time, and having a sufficient bandwidth to produce the necessary navigation precision without recourse to two-way transmission or Doppler integration. The system will provide accurate position determination in three dimensions anywhere on or near the surface of the Earth. GPS provides two navigation accuracy levels: the Precise Positioning Service (PPS) which is available only to selected U.S. government agencies and the Standard Positioning Service (SPS). The SPS accuracies are 100 m (300 m 99.99% probability) for horizontal measurements, 200 m for vertical measurements and time accuracy within 340 ns.

Operation of the GPS with civilian aircraft will begin in early 1994 and is expected to be in routine use by mid-1995.

6.3 GLONASS

The GLONASS system, operated by Russia, also will have 24 satellites when fully operational. Russia continues to launch GLONASS satellites, and, although the program is somewhat behind schedule, it is anticipated that 24 satellites will be in operation by 1995.

Russia, in early 1992, filed for Article 14 coordination for GLONASS, up to 1620 MHz. This filing addresses the use of the precision code in this system. Over 40 administrations, including the United States, filed statements concerning operation of GLONASS up to 1620 MHz, with the Radio Registration Board (RRB).

Because of current interference from GLONASS into radioastronomy, Russia has been negotiating with a number of administrations in an effort to resolve this issue. Current information is that Russia has entered into agreements with Australia and Japan to restrict use of GLONASS to approximately 1608 MHz and below, by 1998, in order to avoid harmful interference into radioastronomy. The Attachment in Appendix A is a copy of correspondence among radio astronomers and it was distributed at a recent USSG Working Party 8D meeting. Within Radiocommunication Study Groups, this issue is being addressed as well. A pending document, 7D/TEMP/17E, proposes a frequency shift for GLONASS.[12]

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[11] 1992 Federal Radionavigation Plan, at p. 17.

[12] To resolve both the MSS/GLONASS and radioastronomy/GLONASS issues, GLONASS would operate on a center frequency no higher than 1605.375 MHz. The GLONASS transmissions should be filtered so that emissions above 1610.6 MHz will be substantially reduced.

Upon confirmation of these agreements, further efforts should be made to determine the certainty that GLONASS will modify its system operations to eliminate transmissions above 1608 MHz. If such a transition is completed by 1998, there will no longer be a need to address the issue of co-channel MSS and GLONASS operations. However, additional work will be required to determine an appropriate out-of-band emission limit on MSS consistent with the requirements of the GNSS.

6.4 Other Systems

In addition to GPS and GLONASS, Japan recently announced its intention to deploy a satellite-based navigation and communications system. See, "Japan Plans GPS Adjunct," Space News, September 13-19, 1993. The system must be approved by the Ministry of Finance and the Japanese parliament. INMARSAT has also announced inclusion of a navigation function in its next generation system. Several of the proposed RDSS/MSS systems will provide navigational capability as well.

Development continues on enhancements to GPS, including differential, and possible additional satellites in the constellation. Consequently, with the numerous identified and potential components to the GNSS, the stated requirement for exceedingly strict protection criteria for transmissions from single GLONASS satellites is clearly unnecessary.

ATTACHMENT

CORRESPONDENCE WITHIN RADIO ASTRONOMY COMMUNITY CONCERNING PROPOSED CHANGES IN THE GLONASS FREQUENCY PLAN

(Distributed at USSG Working Party 8D Meeting, September 27, 1993)